

SECTION 500
DRAINAGE REPORT



4561 E. McDowell Road
Phoenix, AZ 85008
602.454.0402
602.454.0403 (fax)

Memorandum

To: Mr. Steve Riley
Project Manager

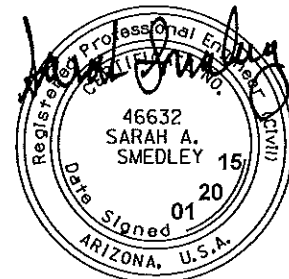
Date: January 21, 2015

Subject: Drainage
Memorandum

Project: Northern Addition Sidewalks
CDBG Project

**AZTEC Project
Number:** AZE1212-05

From: Sarah Smedley, PE
Project Engineer



EXPIRES 6/30/2016

Purpose

The purpose of this technical memorandum is to document the drainage analysis and design of the Northern Addition Sidewalks CDBG Project. There are two main drainage concerns when constructing sidewalk improvements in older subdivisions, street conveyance and adjacent finished floor elevations. Both have been analyzed and the results are presented in this memorandum. A drainage area map and drainage calculations have also been included. Design methodology, criteria and calculations are based on the City of Buckeye's *Storm Water Drainage System Design Manual*.

Existing Conditions

The project is located in the City of Buckeye, Arizona in an area located just north of downtown Buckeye. The subdivision, referred to as the "Northern Addition Plat of Buckeye", was platted in 1929. The project limits include four local streets: Narramore Avenue, Nelson Avenue, Eason Avenue and Edison Avenue between 2nd Street and 4th Street. Edison Avenue is a bid alternate. Currently, these east-west streets have varying widths of pavement with no curb, gutter or sidewalk. The north-south streets in the project limits are recently improved and have curb, gutter and sidewalks. At the intersections with Nelson, Eason and Edison, valley gutters have been constructed to convey street flows to the south.

The overall drainage pattern in the project vicinity is from northwest to southeast. The project streets generally slope to the east. Nelson Avenue, Eason Avenue and Edison Avenue flow east to the north-south streets and the pavement drainage is conveyed south in the existing valley gutters. Narramore from 1st Street to 2nd Street has a one-way crown to the south. There is recently constructed curb and gutter on the south side of Narramore. Flows are conveyed in the existing gutter east to 2nd Street and then south at the intersection. From 2nd Street to 4th Street, the south side of the street flows east to the nearest north-south street and continues south. The north half, however should drain to 4th Street but has pockets of ponding areas, which will be improved through pavement replacement with this project.

During a site visit in July 2014, it was noted that a majority of the homes in the project limits are flood irrigated, with higher finished floors and depressed yards. It was apparent that most of the homes on the south side of the streets are not graded toward the adjacent street as would be done in newer subdivisions, but continue to follow the natural grade of the land.

Floodplain Classification

The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRM) within the project site. The project is located in panel 2580, Map No. 04013C2580L for Maricopa County, Arizona and Incorporated Areas, revised October 16, 2013. The latest FIRM panel for the project has been included with this memorandum as Exhibit 1. The project site is within the FEMA Flood Zone X (Shaded). Zone X (Shaded) is defined as: *"Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths less than one foot or with drainage areas less than one square mile; and areas protected by levees from 1% annual chance flood."*

Proposed Improvements

The proposed pedestrian improvements include the installation of new curb, gutter and sidewalk on both the north and south sides of Narramore between 2nd Street and 4th Street, Eason and Nelson from 3rd to 4th Streets and Edison from 2nd to 4th Streets. Only south curb improvements are proposed for Eason from 2nd Street to 3rd Street, since the north side of the street has new improvements. The proposed curb along the north side of Narramore will extend west past 2nd Street to tie into existing grades without creating an area of ponding at the new curb. With the exception of Edison, all of the streets will now be 32' from back of curb to back of curb, symmetrical about the centerline. Edison, because of existing overhead power lines is shifted 2' to the south between 2nd and 3rd Streets. Edison between 3rd and 4th Streets will be 31' wide, 15' from centerline to the south back of curb, because of the overhead power lines. Concrete driveways, on-street parking with valley gutters and ADA pedestrian ramps will be constructed within the project limits as well. Based on the drainage analysis discussed below, drainage criteria can be met by the construction of either 4-inch or 6-inch vertical curb and gutter and areas of pavement replacement. No other drainage improvements are required.

Street Conveyance

A hydrologic study was performed using the Rational Method and NOAA 14 intensity rates to calculate peak flows at all intersections including offsite flows from north of Narramore. The offsite drainage boundary is the canal just north of Narramore. A Drainage Area Map has been included with this memorandum to present the delineation of the drainage areas. As mentioned above, the project generally slopes from northwest to southeast. Drainage areas include the north block and the adjacent street to determine the flow depths. The results of the hydrologic calculations are included.

The pavement hydraulic calculations were performed to determine the depth of flow at each intersection in the project. Depending on the depth of flow, 4-inch vertical curb, 6-

inch vertical curb or additional drainage improvements are recommended. Average existing longitudinal slopes were used for the analysis.

For Nelson, Eason and Edison, the existing cross slope is fairly flat without a pronounced crown. It was assumed that the peak flows would enter the street and flow equally between the north and south curb line. These three streets have existing valley gutters at each north-south intersection which convey the flows south. Therefore, the peak flows for each block are not additive and are analyzed separately.

Narramore does not have valley gutters and was analyzed differently than the other streets. The existing cross slope of Narramore from 1st to 2nd is one way to the south. Although limited improvements are proposed in this section of Narramore, an analysis was provided to show that the flows will not continue past 2nd Street. Flows in the south curb line will not cross the intersection but continue south in 2nd Street. The one-way crown in Narramore transitions to a normal crown after 2nd Street. It was assumed that the peak flows enter the street and flow equally between the north and south curb line. Due to the existing grades along Narramore from 2nd Street to 4th Street, a constant grade would force the gutter line on the north to be much higher than the south gutter line. To avoid a one-way crown between 2nd and 3rd Streets, a north-south valley gutter will be constructed at 3rd Street. Pavement replacement is proposed at this intersection to ensure it drains properly. Narramore from 2nd Street to 3rd Street will drain east to 3rd Street then drain south in 3rd Street at the valley gutter. Narramore from 3rd Street to 4th Street will drain east to 4th Street then south at 4th Street.

An existing church parking lot at the southwest corner of Narramore and 3rd Street currently accepts flows from Narramore into an existing grate catch basin in the center of the parking lot. The new curb and gutter alignment will now contain the flow in Narramore to 3rd Street, bypassing the parking lot. A hydraulic calculation was performed for 3rd Street to verify that the additional flows are contained within the section. The results show that the flows are contained with a flow depth of 4-inches.

Finished Floor Elevations

When new subdivisions are designed, finished floor elevations are typically built 14-inches above the low top of curb to ensure positive drainage to adjacent streets. A concern with installing curb, gutter and sidewalks in older subdivisions, such as Northern Addition, occurs if the proposed curb is higher than the adjacent finished floors, potentially creating ponding and flooding issues. AZTEC surveyed each finished floor elevation within the project boundary. Although the finished floors were not high enough to meet current standards and requirements, all of the houses and businesses on the north side of each street are higher than the proposed top of curb. On the south side, all but two of the homes and businesses are higher as well. On Eason, APN 400-20-055, the finished floor elevation is at the same elevation as the low top of curb. In this location, the existing edge of pavement is only 0.01' lower than the proposed top of curb. This is an existing problem and the proposed improvements are not making the condition worse. The other home is on the south side of Edison between 2nd Street and

3rd Street and has a finished floor elevation at the same elevation as the low top of curb. It is located at the southwest corner of the 3rd Street intersection, APN 400-20-048. Fortunately, this home fronts Roosevelt and the lot drains to the south to Roosevelt. The new curb on Edison will reduce runoff to this lot, thereby improving the lot's drainage conditions. There are also a few homes where a finished floor elevation was not obtained. They were not obtained because these homes fronted Roosevelt or the north-south streets and do not drain to Edison.

Conclusion

Based on the results of the hydraulic calculations it was determined that the streets provide adequate hydraulic capacity to convey the runoff to the north-south streets with no additional drainage improvements, such as curb inlets, retention basins or storm drain. All of the streets have the necessary capacity to convey the peak flows using 4-inch vertical curb except for Narramore between 2nd and 3rd Street. This will require 6-inch vertical curb along the south curb line and 4-inch curb on the north side to convey the 10-year flows without overtopping. The hydraulic calculations are included in this memorandum.

The results of the comparison between the existing finished floor elevations and the proposed top of curb elevations indicate that this project will not create any adverse impacts on the existing neighborhood. Storm water runoff will still drain away from structures and into the adjacent streets. These improvements will not have a negative impact on the flood irrigated properties as well.

Attachments

- FEMA FIRM Panel
- Drainage Area Map
- Hydrology Calculations
- Hydraulic Calculations
- Sidewalk Plans with Finished Floor Elevations



4561 E. McDowell Road
Phoenix, AZ 85008
602.454.0402
602.454.0403 (fax)

Exhibits

1. FEMA FIRM Panel
2. Drainage Area Map

FEEDBACK	STATE	PROJECT NO.	NO.	TOTAL	AS BUILT
X	ARIZ.	XXXXXXXXXX		300X	



LEGEND

- DA03 DRAINAGE AREA 10
- DRAINAGE AREA BOUNDARY
- ~ DIRECTION OF FLOW



CITY OF BUCKEYE, ARIZONA			
STREET TRANSPORTATION DEPARTMENT			
NORTHERN ADDITION SIDEWALKS CDBG			
EXHIBIT 2: DRAINAGE AREA MAP			
AZE1212-05			
DATE: 11/13	DATE: 11/14	DATE: 11/14	DATE: 11/14
SCALE:			



4561 E. McDowell Road
Phoenix, AZ 85008
602.454.0402
602.454.0403 (fax)

Hydrology Calculations



Precipitation

FCDMC Isopluvial Maps & NOAA ATLAS 14

Project:	Northern Addition Sidewalks CDBG Project	By:	Sarah Smedley
Client:	City of Buckeye	Date:	8/20/2014
		Project #:	AZE1212-05

RAINFALL DEPTH-DURATION-FREQUENCY SITE SPECIFIC D-D-F TABLE

Frequency (N-year)	Rainfall Depth (inches)									
	Duration									
	5-min	10-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	24-hour
2	0.26	0.40	0.49	0.67	0.82	0.91	0.95	1.10	1.19	1.50
5	0.36	0.55	0.68	0.91	1.13	1.23	1.27	1.43	1.54	1.95
10	0.43	0.65	0.81	1.09	1.35	1.48	1.52	1.70	1.82	2.30
25	0.53	0.80	0.99	1.33	1.65	1.81	1.88	2.07	2.20	2.79
50	0.60	0.91	1.13	1.52	1.88	2.07	2.16	2.36	2.49	3.18
100	0.67	1.02	1.26	1.70	2.11	2.34	2.46	2.67	2.80	3.59
500	0.84	1.28	1.58	2.13	2.64	2.98	3.23	3.45	3.55	4.59

Frequency (N-year)	Rainfall Intensity (inches/hour)									
	Duration									
	5-min	10-min	15-min	30-min	1-hour	2-hour	3-hour	6-hour	12-hour	24-hour
2	3.14	2.39	1.98	1.33	0.82	0.45	0.32	0.18	0.10	0.06
5	4.30	3.27	2.70	1.82	1.13	0.62	0.42	0.24	0.13	0.08
10	5.16	3.92	3.24	2.18	1.35	0.74	0.51	0.28	0.15	0.10
25	6.30	4.79	3.96	2.66	1.65	0.91	0.63	0.35	0.18	0.12
50	7.16	5.45	4.52	3.04	1.88	1.04	0.72	0.39	0.21	0.13
100	8.03	6.12	5.04	3.40	2.11	1.17	0.82	0.45	0.23	0.15
500	10.06	7.68	6.32	4.26	2.64	1.49	1.08	0.58	0.30	0.19

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS
Location:	Buckeye, AZ	Checked By:	TAB



Drainage Basin: DA01

Length of Longest Flowpath = 368 feet
0.07 miles

Upper Elevation = 885.00 feet

Lower Elevation = 880.50 feet

Slope of Longest Flowpath = 64.65 ft/mi

Kb = 0.0405

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	5.2	
8	4.42	5.3	
9	4.17	5.4	
10	3.92	5.6	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision = 0.60

C₁₀ Paved = 0.95

C₁₀ Composite = 0.71

I = 3.92 in/hr

Area Subdivision = 0.57 acres

Area Paved = 0.27 acres

Total Area = 0.84 acres

10-Year Storm Event = 2.3 cfs

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	4.4	
8	6.88	4.5	
9	6.50	4.6	
10	6.12	4.7	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision = 0.60

C₁₀₀ Paved = 0.95

C₁₀₀ Composite = 0.71


I = 6.12 in/hr

Area Subdivision = 0.57 acres

Area Paved = 0.27 acres

Total Area = 0.84 acres

100-Year Storm Event = 3.7 cfs

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015	
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS	
Location:	Buckeye, AZ	Checked By:	TAB	

Drainage Basin: DA02

Length of Longest Flowpath = 509 feet
0.10 miles

Upper Elevation = 884.50 feet
Lower Elevation = 870.70 feet

Slope of Longest Flowpath = 143.26 ft/mi
Kb = 0.0376

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	4.6	
8	4.42	4.7	
9	4.17	4.8	
10	3.92	4.9	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision = 0.60
C₁₀ Paved = 0.95
C₁₀ Composite = 0.66
I = 3.92 in/hr
Area Subdivision = 1.98 acres
Area Paved = 0.40 acres
Total Area = 2.38 acres

10-Year Storm Event = 6.2 cfs

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	3.9	
8	6.88	4.0	
9	6.50	4.1	
10	6.12	4.2	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision = 0.60
C₁₀₀ Paved = 0.95
C₁₀₀ Composite = 0.66
I = 6.12 in/hr
Area Subdivision = 1.98 acres
Area Paved = 0.40 acres
Total Area = 2.38 acres

100-Year Storm Event = 9.6 cfs

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015	
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS	
Location:	Buckeye, AZ	Checked By:	TAB	

Drainage Basin: DA03

Length of Longest Flowpath = 581 feet
0.11 miles
Upper Elevation = 884.00 feet
Lower Elevation = 878.50 feet
Slope of Longest Flowpath = 49.97 ft/mi
Kb = 0.0374

$$T_c = 11.4 L^{0.58} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	6.8	
8	4.42	7.0	
9	4.17	7.1	
10	3.92	7.3	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision = 0.60
C₁₀ Paved = 0.95
C₁₀ Composite = 0.64
I = 3.92 in/hr
Area Subdivision = 2.30 acres
Area Paved = 0.30 acres
Total Area = 2.60 acres

10-Year Storm Event = 6.5 cfs

$$T_c = 11.4 L^{0.58} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	5.8	
8	6.88	5.9	
9	6.50	6.0	
10	6.12	6.1	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision = 0.60
C₁₀₀ Paved = 0.95
C₁₀₀ Composite = 0.64
I = 6.12 in/hr
Area Subdivision = 2.30 acres
Area Paved = 0.30 acres
Total Area = 2.60 acres

100-Year Storm Event = 10.2 cfs

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS
Location:	Buckeye, AZ	Checked By:	TAB



Drainage Basin: DA04

Length of Longest Flowpath = 510 feet
0.10 miles
Upper Elevation = 879.20 feet
Lower Elevation = 877.00 feet
Slope of Longest Flowpath = 22.80 ft/mi
Kb = 0.0384

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	8.2	
8	4.42	8.4	
9	4.17	8.6	
10	3.92	8.8	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision = 0.60
C₁₀ Paved = 0.95
C₁₀ Composite = 0.65
I = 3.92 in/hr
Area Subdivision = 1.52 acres
Area Paved = 0.27 acres
Total Area = 1.79 acres

10-Year Storm Event = 4.6 cfs

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	7.0	
8	6.88	7.1	
9	6.50	7.3	
10	6.12	7.4	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision = 0.60
C₁₀₀ Paved = 0.95
C₁₀₀ Composite = 0.65
I = 6.12 in/hr
Area Subdivision = 1.52 acres
Area Paved = 0.27 acres
Total Area = 1.79 acres

100-Year Storm Event = 7.2 cfs

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS
Location:	Buckeye, AZ	Checked By:	TAB



Drainage Basin: DA05

Length of Longest Flowpath = 461 feet
0.09 miles
Upper Elevation = 878.00 feet
Lower Elevation = 876.90 feet
Slope of Longest Flowpath = 12.60 ft/mi
Kb = 0.0389

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	9.5	
8	4.42	9.7	
9	4.17	9.9	
10	3.92	10.1	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision = 0.60
C₁₀ Paved = 0.95
C₁₀ Composite = 0.89
I = 3.92 in/hr
Area Subdivision = 0.27 acres
Area Paved = 1.25 acres
Total Area = 1.52 acres

10-Year Storm Event = 5.3 cfs

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	8.0	
8	6.88	8.2	
9	6.50	8.4	
10	6.12	8.6	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision = 0.60
C₁₀₀ Paved = 0.95
C₁₀₀ Composite = 0.89
I = 6.12 in/hr
Area Subdivision = 0.27 acres
Area Paved = 1.25 acres
Total Area = 1.52 acres

100-Year Storm Event = 8.3 cfs

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015	
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS	
Location:	Buckeye, AZ	Checked By:	TAB	

Drainage Basin: DA06

Length of Longest Flowpath = 490 feet
0.09 miles

Upper Elevation = 879.05 feet
Lower Elevation = 875.25 feet

Slope of Longest Flowpath = 40.98 ft/mi
Kb = 0.0385

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	6.7	
8	4.42	6.9	
9	4.17	7.0	
10	3.92	7.2	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision = 0.60
C₁₀ Paved = 0.95
C₁₀ Composite = 0.66
I = 3.92 in/hr
Area Subdivision = 1.44 acres
Area Paved = 0.27 acres
Total Area = 1.71 acres

10-Year Storm Event = 4.4 cfs

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	5.7	
8	6.88	5.8	
9	6.50	5.9	
10	6.12	6.1	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision = 0.60
C₁₀₀ Paved = 0.95
C₁₀₀ Composite = 0.66
I = 6.12 in/hr
Area Subdivision = 1.44 acres
Area Paved = 0.27 acres
Total Area = 1.71 acres

100-Year Storm Event = 6.9 cfs

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015	
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS	
Location:	Buckeye, AZ	Checked By:	TAB	

Drainage Basin: DA07

Length of Longest Flowpath = 537 feet
0.10 miles

Upper Elevation = 877.48 feet
Lower Elevation = 875.27 feet

Slope of Longest Flowpath = 21.74 ft/mi
Kb = 0.0382

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	8.6	
8	4.42	8.7	
9	4.17	8.9	
10	3.92	9.1	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision = 0.60
C₁₀ Paved = 0.95
C₁₀ Composite = 0.65
I = 3.92 in/hr
Area Subdivision = 1.68 acres
Area Paved = 0.28 acres
Total Area = 1.96 acres

10-Year Storm Event = 5.0 cfs

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	7.2	
8	6.88	7.4	
9	6.50	7.5	
10	6.12	7.7	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision = 0.60
C₁₀₀ Paved = 0.95
C₁₀₀ Composite = 0.65
I = 6.12 in/hr
Area Subdivision = 1.68 acres
Area Paved = 0.28 acres
Total Area = 1.96 acres

100-Year Storm Event = 7.8 cfs

Project Name:	Northern Addition Sidewalks Project	Date:	1/19/2015
Subject:	10-Yr & 100-Yr Peak Discharges	Computed By:	SAS
Location:	Buckeye, AZ	Checked By:	TAB



Drainage Basin: DA08

Length of Longest Flowpath = 520 feet
0.10 miles

Upper Elevation= 876.88 feet

Lower Elevation= 874.40 feet

Slope of Longest Flowpath = 25.21 ft/mi

Kb = 0.0384

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 10-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	4.67	8.1	
8	4.42	8.2	
9	4.17	8.4	
10	3.92	8.6	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀ Subdivision= 0.60

C₁₀ Paved= 0.95

C₁₀ Composite= 0.65

I= 3.92 in/hr

Area Subdivision= 1.56 acres

Area Paved= 0.26 acres

Total Area= 1.82 acres

10-Year Storm Event= 4.6 cfs

$$T_c = 11.4 L^{0.50} K_b^{0.52} S^{-0.31} I^{-0.38}$$

Trials 100-Year Event

Tc (min)	I (in/hr)	Calculated Tc (min)	
7	7.26	6.8	
8	6.88	7.0	
9	6.50	7.1	
10	6.12	7.3	OK

*Minimum Tc = 10 min

Denotes information that needs to be entered.

Q=CIA

C₁₀₀ Subdivision= 0.60

C₁₀₀ Paved= 0.95

C₁₀₀ Composite= 0.65

I= 6.12 in/hr

Area Subdivision= 1.56 acres

Area Paved= 0.26 acres

Total Area= 1.82 acres

100-Year Storm Event= 7.2 cfs



4561 E. McDowell Road
Phoenix, AZ 85008
602.454.0402
602.454.0403 (fax)

Hydraulic Calculations

10-Year Event Full Street Narramore - 1st-2nd (DA01)

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 0.00630 ft/ft
Discharge 2.30 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00	100.00
0+05	99.93
0+05	99.43
0+37	99.92
0+37	100.27
0+42	100.35

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 100.00)	(0+05, 99.43)	0.015
(0+05, 99.43)	(0+37, 99.92)	0.015
(0+37, 99.92)	(0+42, 100.35)	0.015

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 0.20 ft
Elevation Range 99.43 to 100.35 ft
Flow Area 1.35 ft²
Wetted Perimeter 13.49 ft
Hydraulic Radius 0.10 ft

10-Year Event Full Street Narramore - 1st-2nd (DA01)

Results

Top Width	13.32	ft
Normal Depth	0.20	ft
Critical Depth	0.20	ft
Critical Slope	0.00720	ft/ft
Velocity	1.70	ft/s
Velocity Head	0.04	ft
Specific Energy	0.25	ft
Froude Number	0.94	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.20	ft
Critical Depth	0.20	ft
Channel Slope	0.00630	ft/ft
Critical Slope	0.00720	ft/ft

10-Year Event Narramore - 2nd-3rd (DA02)

Project Description

Solve For Spread

Input Data

Channel Slope	0.00200	ft/ft
Discharge	3.10	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.015	

Results

Spread	22.04	ft
Flow Area	2.48	ft ²
Depth	0.29	ft
Gutter Depression	0.07	ft
Velocity	1.25	ft/s

10-Year Event 3rd Street South of Narramore

Project Description

Solve For Spread

Input Data

Channel Slope	0.00250	ft/ft
Discharge	5.40	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.015	

Results

Spread	26.17	ft
Flow Area	3.48	ft ²
Depth	0.33	ft
Gutter Depression	0.07	ft
Velocity	1.55	ft/s

10-Year Event Narramore - 3rd-4th (DA03)

Project Description

Solve For Spread

Input Data

Channel Slope	0.00200	ft/ft
Discharge	3.30	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.015	

Results

Spread	22.59	ft
Flow Area	2.60	ft ²
Depth	0.30	ft
Gutter Depression	0.07	ft
Velocity	1.27	ft/s

10-Year Event Nelson - 3rd-4th (DA04)

Project Description

Solve For Spread

Input Data

Channel Slope	0.00700	ft/ft
Discharge	2.30	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.01	ft/ft
Roughness Coefficient	0.015	

Results

Spread	15.27	ft
Flow Area	1.22	ft ²
Depth	0.22	ft
Gutter Depression	0.07	ft
Velocity	1.88	ft/s

10-Year Event Eason - 2nd-3rd (DA05)

Project Description

Solve For Spread

Input Data

Channel Slope	0.00280	ft/ft
Discharge	2.70	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	

Results

Spread	12.70	ft
Flow Area	1.66	ft ²
Depth	0.31	ft
Gutter Depression	0.06	ft
Velocity	1.63	ft/s

10-Year Event Eason - 3rd-4th (DA06)

Project Description

Solve For Spread

Input Data

Channel Slope	0.00500	ft/ft
Discharge	2.20	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	

Results

Spread	10.45	ft
Flow Area	1.13	ft ²
Depth	0.27	ft
Gutter Depression	0.06	ft
Velocity	1.94	ft/s

10-Year Event Edison - 2nd-3rd (DA07)

Project Description

Solve For Spread

Input Data

Channel Slope	0.00230	ft/ft
Discharge	2.50	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	

Results

Spread	12.81	ft
Flow Area	1.68	ft ²
Depth	0.31	ft
Gutter Depression	0.06	ft
Velocity	1.48	ft/s

10-Year Event Edison - 3rd-4th (DA08)

Project Description

Solve For Spread

Input Data

Channel Slope	0.00310	ft/ft
Discharge	2.30	ft ³ /s
Gutter Width	1.50	ft
Gutter Cross Slope	0.06	ft/ft
Road Cross Slope	0.02	ft/ft
Roughness Coefficient	0.015	

Results

Spread	11.69	ft
Flow Area	1.41	ft ²
Depth	0.29	ft
Gutter Depression	0.06	ft
Velocity	1.63	ft/s



4561 E. McDowell Road
Phoenix, AZ 85008
602.454.0402
602.454.0403 (fax)

Sidewalk Plans with Finished Floor Elevations